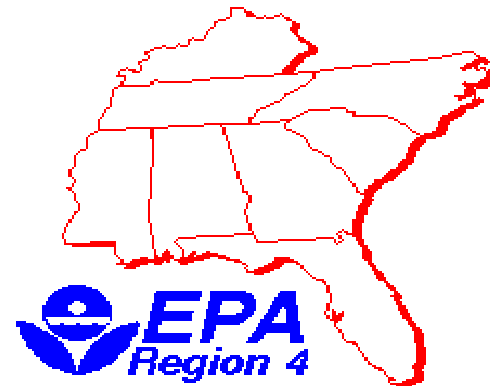# Understanding Modeling Data in Risk Characterization

Kenneth L. Mitchell, Ph.D.; Chief
Air Toxics Assessment and Implementation Section
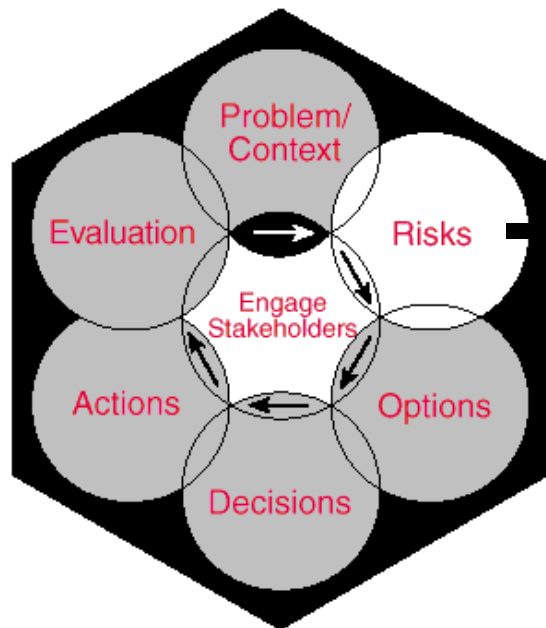**USEPA Region 4**
Atlanta, Georgia

Outline

- **Modeling as an Input into the risk assessment process**

- **Inputs to air dispersions models and uncertainties**

- **Common Air Dispersion Models and uncertainties**

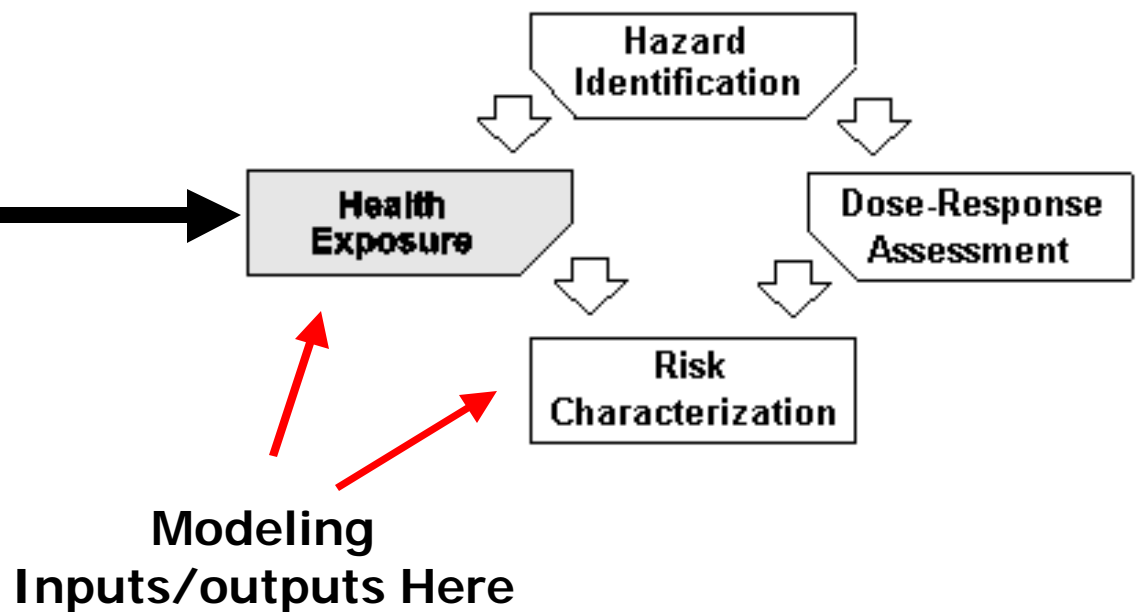- **Common Exposure Models and uncertainties**

- **NATA - a case study**

Goal: Highly Certain Risk Characterization Based on Modeled Results

The Risk Assessment/Management Paradigms

Risk Management Paradigm

Risk Assessment Paradigm

Problem/Context

Evaluation

Risks

Engage Stakeholders

Actions

Options

Decisions

Hazard Identification

Health Exposure

Dose-Response Assessment

Risk Characterization

Modeling Inputs/outputs Here

Planning for a Modeling Study

- **The choice of models and the way they are applied will depend on numerous factors such as:**
    - Spatial scale (e.g., national, regional, or local)
    - Temporal scale (e.g., hourly, daily, or annual)
    - Type of pollutant (e.g., gaseous, particulate, reactive)
    - Media and pathways (e.g., air, water, soil, inhalation, ingestion)
    - Type of receptors (e.g., general public, sensitive populations, workers, terrestrial ecosystems, aquatic ecosystems)
    - Emission source type (e.g., stationary, mobile, elevated, complex terrain)
    - Availability of input data (including meteorological data)
    - An acceptable level of uncertainty in the model's results
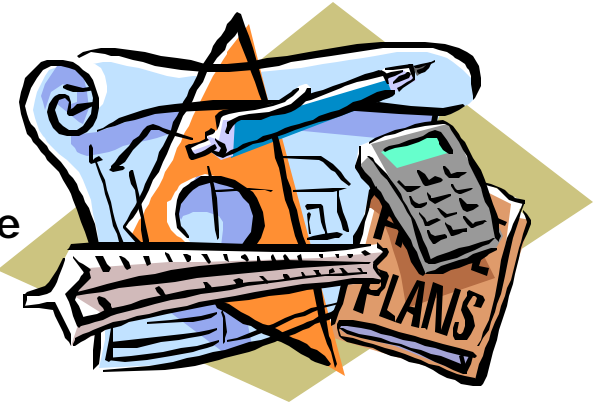
Emissions Inventories

- **There are a number of types of emissions inventories available**
  - **National databases**
    - **National Emissions Inventory**
    - **Toxics Release Inventory**
  - **State and local air agencies**
- **Select inventory inputs for air dispersion models based on study objectives and resources**
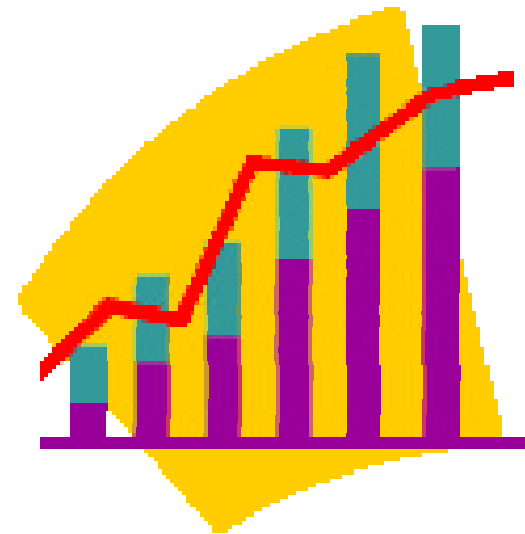
National Emissions Inventories

- **National Emissions Trends Database (NET)- Criteria Pollutants**
  - **1985 - 1999**
- **National Toxics Inventory (NTI)- Toxics Pollutants**
  - **NTI from 1993 - 1999**
- **National Emissions Inventory (NEI) Replaces NET and NTI**
 - **NEI 1999 forward every 3 years**

National Emissions Inventory

- **What Pollutants Are in the Inventory?**
  - SOx
  - VOC
  - NOx
  - CO
  - PM10
  - PM2.5
  - NH3
  - HAPs (188)
- **Includes information on point, area, mobile, and biogenic sources**
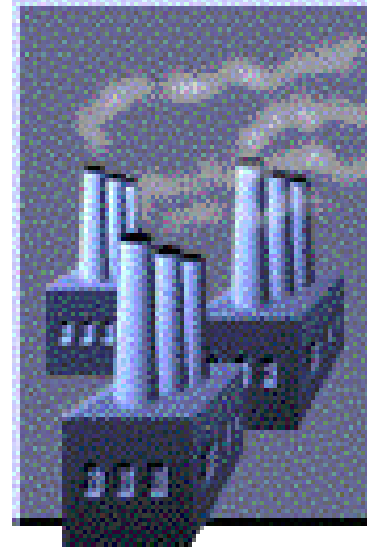
Toxics Release Inventory

- **Approximately 650 chemicals and chemical categories reported**
- **Mid- to large facilities are subject**
  - **SIC 20-39**
  - **Metal & coal mining**
  - **Coal fired power plants**
  - **Chemical wholesale distributors**
  - **Petroleum bulk distribution and storage**
  - **RCRA Subtitle C TSDs**
  - **Solvent recovery services**
- **Includes releases to air, water, land, UIC, and transfers off-site**
- **Includes waste management information**

**1999 TRI On-site Releases
US Totals**

28%

4%

4%

64%

- Air
- Surface Water
- UIC
- Land
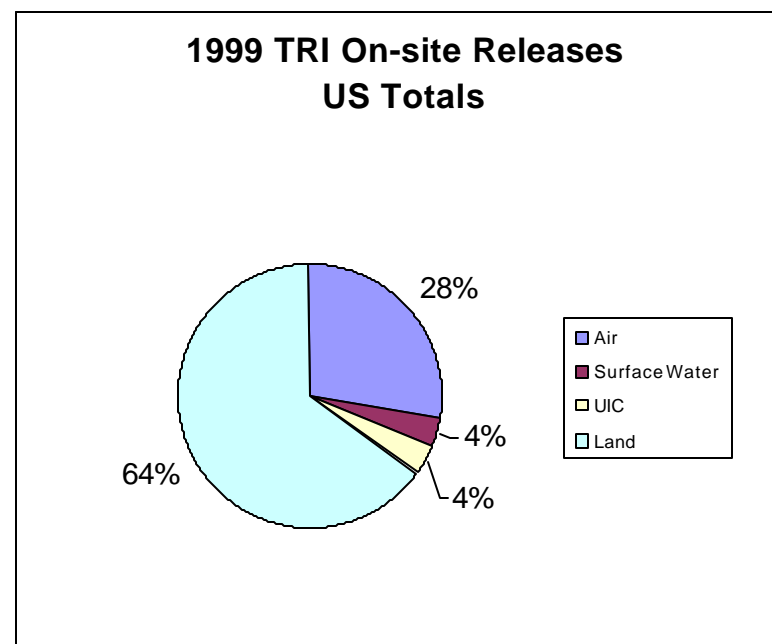
Emissions Inventories – Analysis Tools

- **Data Miner**
  - **Allows for the selective querying of large air toxics data sets**
- **TRI Explorer**
  - **A user-friendly search engine that helps users to sort and download reported toxic chemical release data for specific facilities, counties, states, and U.S. territories**
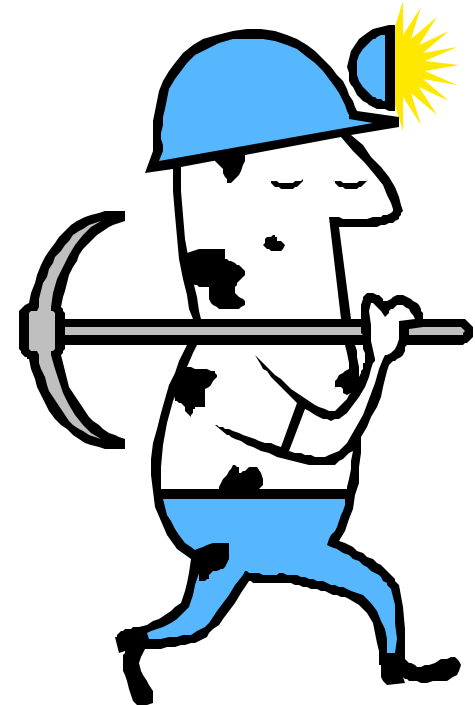
So....is it right???

- **Uncertainties in Emissions Inventories**
  - Consistency (different data from different sources)
  - Completeness issues, unreported data
  - Variability in quality/accuracy of emission estimation methods
  - Unspeciated and mixture data (e.g., gasoline, fuel oil)
  - Confidential data
  - Location-specific data
  - Lag time in reporting
 - Background concentrations

Commonly Used Air Toxics Dispersion Models for Urban Areas

- **ISC3 - Industrial Source Complex Model, Version 3**
- **ASPEN - Assessment System for Population Exposure Nationwide**
- **AerMod - American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee's Dispersion Model**
- **CalPuff – Puff model developed for CARB**

Uncertainties in Air Modeling

- Model algorithms
- Meteorology
- Deposition
- Reactive decay and secondary formation and other fate and transport information
- Terrain and building downwash effects
- Long-range vs. short-range transport
- Background concentrations
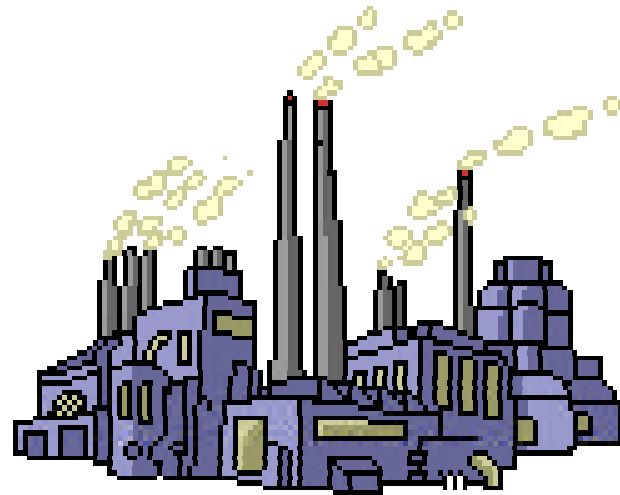
Exposure/Risk Assessment Models

- **Simple Exposure/Risk Scenario**
  - Direct Inhalation (Risk = [X][IUR])

    VERSUS

- **More complex, but more realistic exposure models**
  - HAPEM4 – Hazardous Air Pollutant Exposure Model, Version 4
  - IEM-2M – Indirect Exposure Model, Version 2
  - MPE – Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions
  - HHRAP – Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities
  - TRIM – Total Risk Integrated Methodology

Uncertainty in Exposure/Risk Modeling

- **Activity patterns**
  - **Allocation of time spent in different activities at different locations**
- **Exposure assumptions**
  - **Age, weight, contact rates**
- **Indirect exposure pathways**
  - **Dioxin in food**
  - **Mercury in fish**
- **Toxicity factors**
  - **Animal study results to represent human toxicity**
- **Penetration terms, diurnal cycles, seasonal variation**
- **Acute toxicity**

Some Information Sources…

- Emissions Inventories
    - http://www.epa.gov/ttn/chief/net/index.html
      (CHIEF - Clearinghouse for Inventories and Emissions Factors)
- Air Dispersion Modeling
    - http://www.epa.gov/scram001/
      (SCRAM – Support Center for Regulatory Air Models)
    - http://www.epa.gov/ttn/atw/nata/
      (National Air Toxics Assessment)
- Exposure Modeling
    - http://www.epa.gov/opptintr/exposure/
      (OPPTS Exposure Assessment Tools and Models)
    - http://www.epa.gov/ttn/atw/nata/
      (National Air Toxics Assessment)

Thanks to...

- Ted Palma/OAQPS
- Venkatesh Rao/OAQPS
- Jeff Yurk/EPA Region 6
- Leonardo Ceron/EPA Region 4
- Rick Gillam/EPA Region 4